

REMARKS

Claims 32, 34, 36-45, 47-50 and 51-55 are currently pending in the instant application. By way of the present response, Applicant has amended claims 32, 37, and 42. No new matter has been added. The Examiner has stated that Applicant's previous arguments with respect to claims 32, 34, 36-45, 47-50 and 51-55 were considered but were moot in view of the most recent new ground(s) of rejection. Applicant respectfully requests reconsideration of the present application and the allowance of all claims now presented.

Claim Rejections - 35 U.S.C. § 112

The Examiner has rejected claims 32, 34, 36-45, 47-50 and 51-55 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Specifically the Examiner has stated that recitation of "volumes" and "uncombined" in the claims is unsupported by the specification. Applicant has amended independent claims 32, 37, and 42 by removing all recitations of "volumes" and "uncombined" and, therefore, respectfully requests withdrawal of the 35 U.S.C. 35 U.S.C. 112, first paragraph, rejections.

The Examiner has rejected claims 32, 34, 36-45, 47-50 and 51-55 under 35 U.S.C. § 112, second paragraph, as being indefinite, stating that it is not clear what is

required by the limitation of the “volumes” of the liquid/vapor and DI water as being “uncombined.” Applicant has amended independent claims 32, 37, and 42 to more clearly point out and distinctly claim the subject matter which Applicant regards as the invention by removing all recitations of “volumes” and “uncombined.” Applicant, therefore, respectfully requests withdrawal of the 35 U.S.C. 35 U.S.C. 112, second paragraph, rejections.

Claim Rejections - 35 U.S.C. § 102

In the previous Office Action dated September 20, 2006, the Examiner rejected claims 32, 37, 41, 47 and 48 under 35 U.S.C. § 102(b) as being anticipated by EP 095747, and also under 35 U.S.C. § 102(e) as being anticipated by Mertens et al, US Patent No. 6,491,764, hereinafter “Mertens.” The Examiner also rejected claims 32, 34, 36-38, 40-44, and 46-50 under 35 U.S.C. § 102(e) as being anticipated by Lorimer, US Patent No. 6,460,552, hereinafter “Lorimer.”

Claims 32, 37, and 41 (EP 0905747 and Mertens)

Claim 32, 37, and 41 relate to a method of cleaning a wafer comprising: exposing the frontside of the spinning wafer to an etchant or cleaning chemicals, then applying a liquid (claim 32) or vapor produced from a liquid (claim 37) having a lower surface tension than water, then applying liquid DI water, wherein the

liquid (claim 32) or vapor produced from a liquid (claim 37) having a lower surface tension than water and the liquid DI water are each applied separately.

It is Applicant's understanding EP 0905747 and Mertens are closely related and therefore Applicant discusses them together herein. In summary, it is Applicant's understanding that EP 0905747 and Mertens fail to disclose or suggest (1) applying a liquid having a lower surface tension than water, and (2) applying liquid DI water separately (i.e. not simultaneously to or while to other is applied).

Firstly, it is Applicant's understanding that EP 0905747 and Mertens are limited to applying a "gaseous substance" to the surface of a substrate, mixing the gaseous substance with a liquid and yielding a mixture having a surface tension lower than the liquid. In [0024] of EP 0905747, the term "gaseous substance" is defined as either comprising: a vaporized substance or gas. As is differentiated by Applicant in claims 32 and 37, liquid and vapor produced from a liquid are distinct from one another. **Accordingly, neither EP 0905747 nor Mertens disclose the element of applying a liquid having a lower surface tension than water as is claimed by Applicant in claim 32.**

Secondly, it is Applicant's understanding that neither EP 0905747 nor Mertens disclose or suggest the element of "wherein the liquid (claim 32) or vapor produced from a liquid (claim 37) having a lower surface tension than water and the liquid DI water are each applied separately." Applicant uses the term "separately" within the specification and claims to necessarily be exclusive of the term "simultaneously." See, for example, [0026] where it is stated:

“In an alternative embodiment of the present invention, one can blow IPA vapor or dispense IPA liquid on the wafer immediately after the chemical dispense step and before DI water is dispensed on the wafer for rinsing. In such a case, the IPA vapor is used to remove the bulk of the chemicals. In yet another embodiment, IPA vapor is blown on the wafer on one spot by the nozzle, simultaneously to or while DI water is dispense on another spot with another nozzle.”

Therefore, the term “separately” as it appears in claim 32 and 37 has a meaning consistent with the specification; that application of the liquid (or vapor of) having a lower surface tension than water and application of the liquid DI water are **performed separately, and not simultaneously to or while the other is applied.**

The Examiner has previously stated that EP 0905747 and Mertens disclose the steps of “spinning a wafer and application to the spinning wafer an etchant or cleaning solution and a gaseous substance having a lower surface tension than water and rinsing and drying” in the order claimed by Applicant in claims 32, 37, 41, 47, and 48. Applicant respectfully disagrees and urges that not only do EP 0905747 and Mertens not disclose the successive and separate steps claimed by Applicant but that the references additionally teach away from the claimed steps by specifically disclosing and advocating the step of “supplying a surface tension reducing gaseous substance **together with** the liquid.” See EP 0905747 [0011].

The Examiner has pointed to EP 0905747 [0007] – [0017], [0024] – [0031], and more specifically to [0026] and [0028] to provide support for teaching the sequential and separate steps as claimed by Applicant in independent claims 32 and 37. Applicant has again reviewed the entire references and in particular those paragraphs cited by the Examiner, and respectfully points to the following

paragraphs to show that the references do not teach the sequential and separate steps claimed by Applicant.

➤ [0034] – [0035]. Within the scope of these two paragraphs EP 0905747 compares a state of the art method of using only a “surface tension reducing gaseous substance” [0034] to remove a particle contaminated water layer from the topside of a wafer, to “**the method of the present invention**” where “A pressurized surface tension reducing gaseous substance, i.e. a mixture of vaporized isopropyl alcohol (IPA) and nitrogen, is actively supplied by the first nozzle, while a liquid, i.e. fresh water, is actively supplied by the second nozzle.” [0035] Thus, EP 0905747 characterizes the method of its invention as supplying a vapor at the same time as supplying liquid fresh water, and fails to recognize the advantages, as claimed by Applicant, of separately and successively applying a liquid (or vapor produced from a liquid) having a lower surface tension than water, *and then* a DI water rinse.

➤ [0034]. “The liquid-vapor boundary is located in between the nozzle providing the surface tension reducing gaseous substance and the nearest nozzle spraying the liquid. Using this method fresh liquid with very low concentration of the surface tension reducing gaseous substance is supplied at the liquid-vapor boundary thus maximizing the removal of the liquid ...” Thus, by implication, for the liquid-vapor boundary to be located between the gaseous substance nozzle and the liquid nozzle, both nozzles must be supplying at the same time in order to create the liquid-vapor boundary.

➤ Abstract. “Simultaneously or thereafter besides the liquid also a gaseous substance can be supplied thereby creating at least a sharply defined liquid-vapor boundary.” Thus, the liquid and gaseous substance are supplied at the same time to create the sharply defined liquid-vapor boundary. It is to be appreciated that the word “thereafter” is not to be interpreted as a completely separate step, as Applicant claims in claims 32 and 37. Instead, “thereafter” is interpreted as having a later start time, but nonetheless must be applied at an overlapping time in order to create the sharply defined liquid-vapor boundary.

➤ [0026]. “To initiate the removal process, besides said liquid also a gaseous substance is sprayed on at least one surface of said substrate.” Thus, the liquid removal process of EP 0905747 requires the liquid and gaseous substance to be applied at the same time. Otherwise, the liquid-vapor boundary that is required for the removal process would not be created.

➤ [0027]. “Preferably the implementation has to be such that the gaseous substance is supplied initially at or very close to the centre of the rotary movement, while the liquid is supplied out of the centre but adjacent to the gaseous substance supply.” Thus, the gaseous substance is supplied while the liquid is supplied.

➤ [0028]. “According to the method of the present invention the first liquid can be supplied on a surface of a substrate at or very close to the centre of the rotary movement, while there is no gaseous substance supply. Then, the liquid is moved slightly out of said centre and the gaseous substance is supplied at said

centre.” Thus, while the application of the liquid and gaseous substance do not have to start at the same time, they are applied simultaneously at some time.

➤ [0029]. “Further according to the method of the present invention the first liquid can be supplied on a surface of the substrate at or very close to the centre of the rotary movement, while substantially simultaneously the gaseous substance is supplied adjacent to said liquid supply.” Thus, the term simultaneously as used in EP 0905747 is referring to the start times of supplying the liquid and gaseous substance. Here they are started at the same time. Yet, as taught above in [0028], it is clear that while EP 0905747 does not require starting the supply of liquid and the gaseous substance at the same time, they must be supplied simultaneously at some time.

➤ [0029]. “Once a liquid-vapor boundary is established, at least locally, both the liquid supply and the gaseous substance supply are moved such that the liquid-vapor boundary is guided outwards.” This statement, describes the object of EP 0905747 where both the gaseous substance must be applied while the liquid is applied in order to create the local liquid-vapor boundary, and then the supplies are moved such that the boundary is guided outwards.

➤ [0030]. “Then the gaseous substance supply system, e.g. a nozzle is moved to the centre of the rotary movement, i.e. the centre of the substrate, and the pressurized gaseous substance is supplied actively at said centre while the liquid is supplied slightly out of centre.”

Accordingly, Applicant respectfully submits that neither EP 0905747 nor Mertens disclose or suggest the element of “wherein the liquid (claim 32) or vapor produced from a liquid (claim 37) having a lower surface tension than water and the liquid DI water are each applied separately.” Applicant submits that it is clear from the cited paragraphs above that EP 0905747 and Mertens are limited to a cleaning and drying process where a local liquid-vapor boundary is created by simultaneously applying both a gaseous substance and liquid. The local liquid-vapor boundary is then guided to the edge of the wafer by moving the gaseous substance and liquid sources.

Additionally, EP 0905747 does compare the above described process to a conventional process utilizing a state of the art method using only a “surface tension reducing gaseous substance” [0034] to remove a particle contaminated water layer from the topside of a wafer. However, this state of the art method additionally fails to disclose all elements as claimed by Applicant in claims 32 and 37.

Applicant teaches that chemical removal from a wafer involves a combination of both convection and diffusion. However, only diffusion is a factor in the region close to the surface of the wafer. The rate of diffusion on chemicals is a function of the thickness of the boundary layer near the surface, see paragraph [0013] of Applicant’s specification. In order to save on the costs associated in both material costs and disposal costs of low surface tension liquids, such as IPA, and to a much lesser extent DI water, the methods to clean wafers need to reduce the usage of IPA, while still providing clean wafer surfaces. Applying IPA only initially is effective in

diffusing the chemicals from the surface and then flushing the diffused chemicals later with DI water. This is an effective method of dramatically reducing the use of expensive IPA. Further, this method also reduces the time required to achieve comparable cleans. Both the cleaning method of EP 0905747, and the state of the art method described in EP 0905747 fail to recognize these advantages and both of those methods apply IPA continuously, which requires much larger quantities of IPA to achieve the same clean and requires more time than the method taught and claimed by Applicant.

In view of the above remarks, a specific discussion of dependent claim 41 is considered to be unnecessary. Therefore, Applicant's silence regarding dependent claim 41 is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Accordingly, Applicant respectfully requests withdrawal of the § 102 rejections of claims 32, 37, and 41 as being anticipated by EP 0905747 and Mertens.

Claims 47 and 48 (EP 0905747 and Mertens)

Claim 47 and 48 relate to a method of cleaning a wafer comprising: after exposing said frontside of said spinning wafer to DI water, blowing a fluid or gas at the center of the frontside of said wafer while said wafer is spinning to remove a DI water bulge formed at the center of the wafer.

It is Applicant's understanding that that EP 0905747 and Mertens fail to disclose or suggest blowing a fluid or gas at the center of the wafer while the wafer

is spinning to remove a DI water bulge formed at the center of the wafer. EP 0905747 and Mertens fail to recognize that DI water may bulge at the center of a spinning wafer due to reduced centripetal forces at the center, thus requiring an additional mechanism to address this problem.

Accordingly, Applicant respectfully requests withdrawal of the § 102 rejections of claims 47 and 48 as being anticipated by EP 0905747 and Mertens.

Claims 32, 34, 36-38, 40-44, and 46-50 (Lorimer)

Lorimer also fails to disclose or suggest separately applying a liquid (or vapor produced from a liquid) having a lower surface tension than water, and applying a liquid DI water rinse. In fact, Lorimer teaches away from the use of a separate and liquid DI water rinse and instead Lorimer applies the low surface tension vapor and water vapor combined as a single steam rinse. See col. 7. Specifically, Lorimer discloses a workpiece cleaning system including a “vapor phase inlet positioned to apply a vapor phase to a first surface of the workpiece.” Col. 4, lines 55-56. Then, “[t]he steam entering nozzle area 138 impinges on the wafer 30 near the center, and is quickly condensed as it proceeds toward the outer diameter by the relatively cool wafer.” Col. 10, lines 33-37. Thus, it is clear that the steam vapor entering the chamber 48 is **applied to the wafer in a gaseous phase**, and that the gaseous stem does not condense and form a liquid until after it is applied. To the contrary, Applicant claims “applying a liquid DI water,” and not a vapor.

Further in col. 12, Lorimer appears to disclose the removal of a clean and dry wafer after the (optionally) combined vapors application, **without the subsequent liquid DI water rinse**. In col. 12, Lorimer discloses using a steam rinse in which isopropyl alcohol is optionally added. Lorimer does fails to disclose subsequently applying liquid DI water.

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicant's silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Accordingly, Applicant respectfully requests withdrawal of the rejections of claims 32, 34, 36-38, 40-44, and 46-50 under 35 U.S.C. § 102(e) as being anticipated by Lorimer.

Claim Rejections - 35 U.S.C. § 103

In the previous Office Action dated September 20, 2006, the Examiner alternatively rejected claims 39 and 45 under 35 U.S.C. § 103(a) as being unpatentable over Lorimer in view of Chang et al., U.S. Patent No. 6,273,099 ("Chang").

Chang discloses an immersion rinse with heated DI water for batch processing, followed by three or more rinses. Chang fails to disclose or suggest a single wafer process, nor the steps of applying a chemical, followed by a surface

tension lowering fluid, and then a separate DI rinse. Therefore, Chang fails to remedy the deficiencies of Lorimer, Mertens, and EP 0905747.

Chang is introduced to disclose the use of heated DI water. However, it is unclear why a skilled artisan would combine Chang specifically with the prior art of record to produce the claimed invention. The art associated with batch processing is not necessarily analogous to single wafer processing. Chang discloses three or more rinses, which is very time consuming and would render the combination impractical in a single wafer process.

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicants' silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claims 39 and 45 under 35 U.S.C. § 103(a) as being unpatentable over Lorimer in view of Chang.

In the previous Office Action dated September 20, 2006, the Examiner rejected claims 38 and 39 under 35 U.S.C. § 103(a) as being unpatentable over any one of Mertens or EP 0905747 in view of Chang. In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicants' silence regarding any dependent claim is not to be interpreted as

agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claims 38 and 39 under 35 U.S.C. § 103(a) as being unpatentable over any one of Mertens or EP 0905747 in view of Chang.

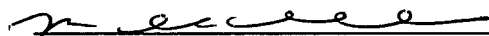
Pursuant to 37 C.F.R. 1.136(a)(3), applicant(s) hereby request and authorize the U.S. Patent and Trademark Office to (1) treat any concurrent or future reply that requires a petition for extension of time as incorporating a petition for extension of time for the appropriate length of time and (2) charge all required fees, including extension of time fees and fees under 37 C.F.R. 1.16 and 1.17, to Deposit Account No. 02-2666.

Respectfully submitted,

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7/16/07



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